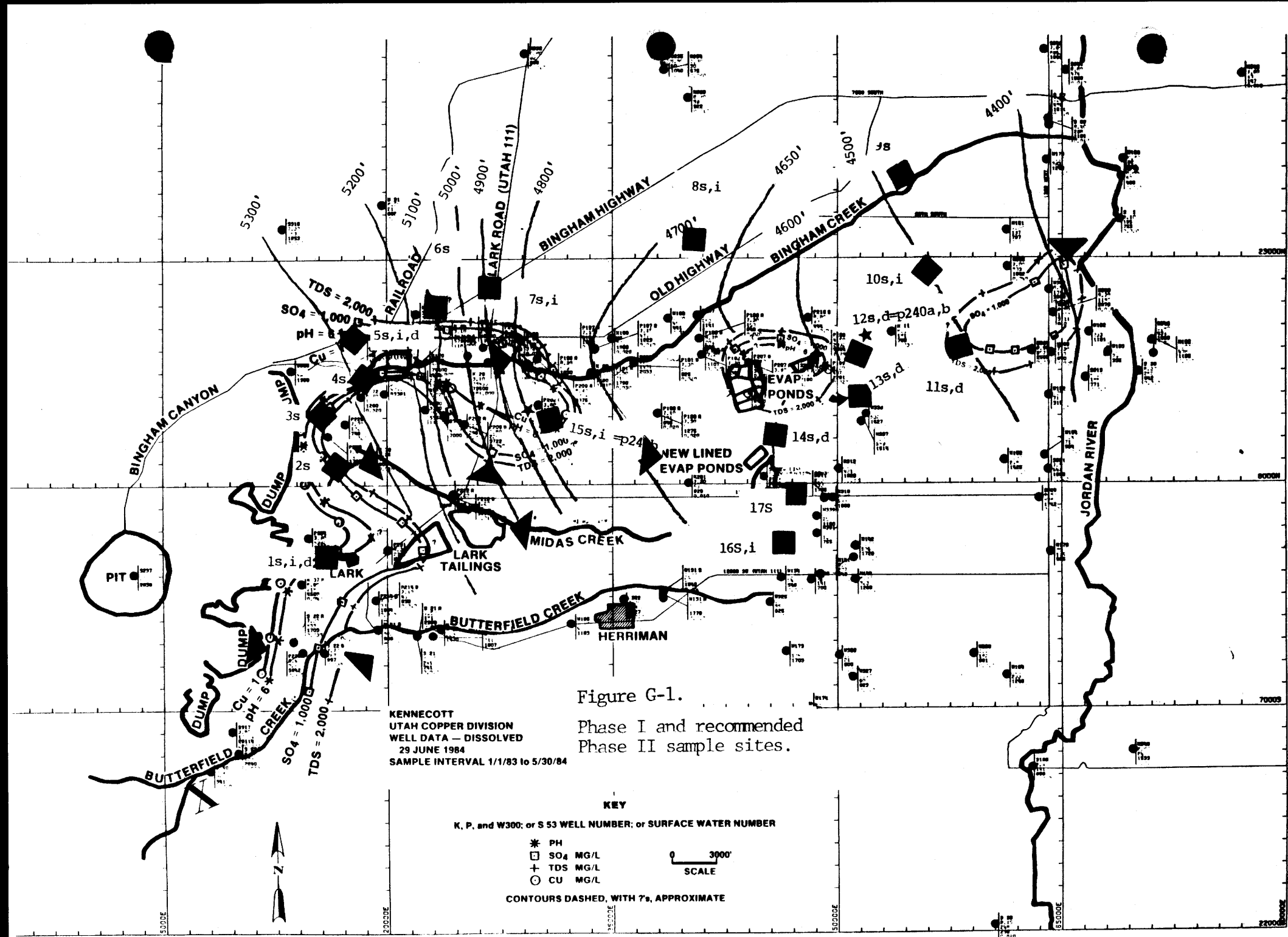

Figure G-1.

Phase I and recommended Phase II sample sites.

4650' Water level contour

X 1. Additional surface water sample site.

PROPOSED WELL SITES FOR PHASEI DRILLING
8. Recommended Phase II

★WELLS ALREADY COMPLETED IN 1984

APPENDIX G

STATE OF UTAH
DEPARTMENT OF HEALTH

NORMAN H. BANGERTER, GOVERNOR

SUZANNE DANDOY, M.D., M.P.H., EXECUTIVE DIRECTOR

March 20, 1985
533-4145

MEMORANDUM

TO: Steve McNeal, UCD Groundwater Study Technical Group

FROM: Joel Hebdon, Staff Engineering Hydrogeologist
Jim Salmon, Environmental Scientist
Ralph Helfer, Lab Implementation Section

THROUGH: Dale D. Parker, Ph.D., Director
Bureau of Solid and Hazardous Waste DDP

SUBJECT: KMC "Draft" Quality Assurance Project Plan

*(Kennecott's responses in parentheses.)

The attached comments were prepared by Jim Salmon (Bureau QA Officer) and Ralph Helfer (State Health Lab QA Officer). The comments are submitted to you in order that they may be considered at the next Technical Group Meeting.

(Dealt with in the overall project plan. Kennecott grouted questionable wells, as agreed to by the Technical Committee in 1983.)

Several fairly serious deficiences in the plan deserve mentioning. These include the probable continued use of inadequate wells in the monitoring program. There may be inadequate construction of future wells. Specifics are included in the comments, but it is a consensus that problems cannot be corrected nor can the future construction of wells be approved until aquifers are identified, hydrologic characteristics, and local hydraulic gradients determined. The site is large, complicating such factors as mounding, perched aquifers, potential density flow, aquicludes etc. The hydrogeology must be looked at in detail. Otherwise, we'll have a lot of data and no idea what it means. A good example would be the comparing of data from a well in the shallow aquifer with data from one finished in the deep aquifer. This appears to have happened in Report 1.

(The hydrogeology must be defined, both regionally, Phase I, and site specific, Phase II.)

(This is a valid comparison.)

In summation, we recommend delaying approval of monitoring well construction until the hydrogeology is adequately addressed. Then, through an updated QA plan. We recommend a thorough review and evaluation of each existing well in the study. Some wells will have to be discarded due to inadequate or unacceptable construction. Only then would we feel comfortable approving new well locations. It is imperative that each utilized well be constructed to the same standards, finished in a discrete, identified portion of the aquifer, and be capable of providing samples whose quality is not subject to question.

(One cannot assess the hydrogeology in more detail until further drilling and monitoring commences!)

An additional subject that we feel should be addressed is the duration of sampling periods. Will samples be collected over four quarters? Quarterly sampling is SOP for initial evaluation of contamination. This should also be discussed, especially in light of what we know about seasonal variations in the Jordan River Valley aquifer system.

(At this point in the study, to define the plume extent, it is not necessary or is it feasible to sample all of the sites on a quarterly basis. We can sample key sites 3/yr for key contaminant indicators.)

(Standard operating procedure for establishing baseline and looking at small changes. Kennecott's present concern is that of defining the major contaminant plume, not minor seasonal fluctuations that can be defined later on, if even necessary, to achieve the study goal.)

(After completing the new monitor wells, we can monitor these on a more frequent basis, if required.)

COMMENTS

KMC "Draft" Quality Assurance Project Plan

1.0 Introduction
Plan has been developed by Kennecott. The technical group has reviewed documents but assumes no individual responsibility for the QA/QC document in particular, not for the groundwater study in general.

(As Joel Hebdon stated at the 3/22/85 technical group meeting, the point that is being made is that Kennecott's QA document is unique to Kennecott's study area, but that the technical group does have final approval of the document.)

2.0 Project Description

2.1 Purpose
Upgradient and downgradient have yet to be established for the aquifer of concern, Characterization of water in existing wells was conducted and reported in the April 1984 report. Characterization of water quality to assess rate and extent of contamination remains to be done. For this purpose a strict QA/QC procedure is being implemented to insure quality of data, comparability of data and usefulness of data.

(Intera Technologies are working on establishing background water quality and on assessing rate and contaminant extent.)

2) Water quality will be compared on what basis? Drinking water quality standards do not apply in this case. Comparisons should be statistical(?). Determination of degradation will be based upon what criteria?

(On background water quality. Until this is established, Drinking Water Standards.)

3) Assessment of existing or potential off-site transport of degraded ground or surface waters will be done by what means? modeling? well installation? specify.

(As stated approximately one year ago, monitoring new wells and modeling.)

Last Paragraph is ambiguous. What does geographically practicable mean? What are "suitable" monitor wells? One upgradient and three downgradient monitor wells will be designated for what? For each potential contaminant source? Will each source then eventually have one upgradient and three downgradient wells? These probable /potential sources haven't yet been identified.

(Wells will be drilled upgradient where it is physically possible. Source areas will be defined in 1985.)

Two important objectives which appear to have been overlooked, but nonetheless, are very important are the site-specific determination of hydraulic gradient, and identification of appropriate groundwater flow zones with their attendant properties. These require the drilling of boreholes, preparation of detailed cross-sections, evaluation of density-flow characteristics of the contaminant liquid, aquifer tests, identification of perched systems, etc.

(Agreed. This first requires additional monitor well drilling, as planned for 1985.)

Additionally, references should be attached to the QA plan, in order that it many stand as an independant document. And finally, a very important aspect of the plan being left unadressed is decontamination. Decontamination procedures should be outlined in detail in each applicable section.

(References are attached for site specific unique reference material, not for EPA and other documents. Such is never done in professional documents.)

3.0 Project Organization and Responsibility
3.1 Organization

The laboratory Manager should be given the additional task of performing QA review. Is Terry Vandell the Project QA Officer?

(Decontamination is required where organic contaminants are present.)

(The laboratory manager does perform the QA water quality data review.)

3.2 The Technical Manager should also be responsible for reporting QA/QC related field activities after each sampling event. These should tie-in to the overall QA/QC plan.

(Yes. Progress Reports.)

The Laboratory Manager should prepare QA reports for review by the Committee after each sampling event.

(Yes. Progress Reports.)

The Project Quality Assurance Officers should review all generated data upon its completion and prepare a statement of validity.

(Yes. Progress Reports.)

5.0 Sampling Procedures
5.1 Sample sites

4.0 Analytical Parameters and QA Objectives
4.1 Cadmium Detecdtion Limits should be lowered as .01? mg/l 0/01 ~~male~~ is the drinking water MCL.
4.2 Total organic halogen limits should be lowered to .25 mg/l

(O.K., to .001.)

(Yes.)

PVC, galvanized steel, or stainless steel are incompatible with analytes and should not be used in the construction of monitor wells except when used in combinations that preclude their coming into contact with groundwater.

(Not a valid statement for this site.)

Specific aquifer zones to be monitored, as detailed in Reference 9, are inadequately described. Hydraulic gradients remain to be determined, aquifers have yet to be described, and hydraulic properties are unknown.

(Described as best as possible with existing data. See Report I.)

Review by the Technical group does not necessarily connote approval. Specifically:

(Review and final approval by the Advisory Group does connote approval.)

1. The drilling methods outlined in Reference 9 indicate inappropriate drilling methods may be used. These include the use of fluid rotary and "any other drilling method reasonably capable of constructing a relatively clean" hole "within a reasonable time span". This is unacceptable.

(This is not valid. See attached Intera response.)

2. PVC and/or stainless steel have not been demonstrated to be non-reactive with the contaminatnts or aquifer fluids to be sampled. Until such demonstration is made, Teflon or equivalent may be the only acceptable construction material.

(This is not valid. The ground-water contaminants at Kennecott are inorganic (metals and sulfate). As pointed out by Intera, "PVC is used in drinking water supplies so it cannot be a major problem.")

Response to 4.2 (1.):

"Air rotary and percussion drilling are never methods of choice when the inorganic chemistry of a water body is to be determined. Both introduce rock flour into the borehole which is more highly reactive and capable of influencing inorganic chemistry than any drilling fluid. The introduction of air into a formation is also a very poor idea because the changes in redox state that it may cause are often not reversible.

The best hydrochemical samples come from rotary holes drilled with a traced drill fluid, preferably water alone. The tracer permits the development of the borehole to remove the drilled fluid to below any predetermined limit. With the other drilling methods there is no explicit means of determining when the effects of drilling have been eliminated."

3. Extending gravel pack "generally 20 to 40 feet" above the screen is unacceptable. 10% of screen interval is the acceptable extension above screen. Extending gravel higher allows aquifer fluids to move between horizons, potentially spreading contamination and diluting samples. Sand pack and grouting should scrupulously adhere to reference 10 guidance.

(Not valid. See response attached from Intera.)

4. Developing wells to produce water as turbid free as practical is undefined. All wells which cannot be developed to produce silt-free water must be replaced as this indicates inadequate construction, (see reference 10).

(Not valid. See Intera response attached.)

5. Well screens shall not exceed 10 feet in length, as per Reference 10.

(Where feasible; i.e., a 10-foot zone is permeable enough to obtain a sample.)

6. -

7. The use of a submersible pump to collect samples is unacceptable. Metals may be stripped by oxidization during pumping.

(Not valid. See Intera response attached.)

Existing (pre-1984) groundwater monitor wells may not be acceptable as sampling points in future portions of the study. Each should be evaluated to determine conformance with the finalized QA/QC plan. If construction details are lacking or if specific portions of specific aquifers being monitored cannot be verified, these wells must be replaced as there will be no way to incorporate data suject to indeterminate variables into comparisons with QA/QC verified data.

(This was completed in 1984 with concurrence from the technical group. As faulty wells are discovered, they will be properly grouted and replaced, if necessary.)

5.2 Sample Collection

The necessity of cleaning(?) old wells indicates that these wells are not in conformance with QA/QC standards and should be replaced. These wells should be inspected and results of such shall determine if the wells will be used in the study.

(Kennecott cannot afford to "replace" wells. The data are valuable and should not be discounted. See Intera response attached.)

Flushing sampling equipment "with waters of drinking water quality" or until stabilization, may be unacceptable. Source of decon waters should be specified. If non-dedicated samplers are to be used, transfer blanks must be taken prior to collecting each sample as required by reference 10. Mixing of sampling methodology (i.e. bailer or pump) is not acceptable.

(Well K349 at Kennecott's field office will be used.)

Filtering gr oundwater sample is not appropriate, see reference 10.

(Kennecott will continue to run filtered and unfiltered analyses for metals. See Intera's response attached.)

Decontamination of bailers is not specified in this section, nor are their construction details. Recovery-to-sample-collection time lags are not specified, nor is methodology for complete decon procedures. Measurement of depth of wells should be included in this list. Calibration of equipment, cleaning of equipment, methodology, etc. should be specified or referenced.

(Well depths were measured in 1984.)

Field Water Quality Data Sheet should be modified to include pre-pumping depth of water to the nearest hundredth foot, initial conductivity (i.e. before evacuation), final conductivity (i.e. at completion of evacuation).

(It does include this.)

Response to 4.2 (3.):

- re: Length of gravel pack: "It would be extremely unwise to attempt to install a gravel pack only 10 percent longer than the screen length at depths of several hundred feet. Screen and gravel pack cannot be placed at that depth with sufficient precision to preclude bentonite sealant from entering the screened interval if such a short pack is attempted. The point that the gravel pack should be extended as short a distance as possible above this screen is well taken and will certainly be observed during the construction of these wells."

Response to 4.2 (4.):

- re: Turbidity-free samples: "Certainly every attempt will be made to construct the wells and collect the samples so that they are as silt-free as possible. In practice, however, a complete absence of sediment is often impossible to obtain, yet information on the chemistry of water at a given location may be absolutely necessary. Filtering samples makes it possible to develop a consistent and reliable picture of ground-water chemistry, even when sediment from these samples cannot be collected. Filtering is mentioned below."

Response to 4.2 (7.):

- re: Use of submersible pump for sampling: "This is an entirely unreasonable prohibition and clearly demonstrates the lack of experience by either the reviewers or the authors of Draft Chapter 3 with field sampling programs to define the inorganic geochemistry of ground waters. Submersible pumps, particularly those with teflon chambers and impellers discharging through PVC line, provide as clean samples for metals and nonvolatile constituents as can be collected. Volatile constituents such as dissolved gases require collection with a downhole sampling apparatus able to collect and maintain the samples at formation pressures. This vessel must then be transported to the laboratory unopened for direct connection to the analytical apparatus. It cannot, as the Draft Chapter 3 suggests, be opened and emptied in the field if any reliable analyses of volatile constituents are to be made."

Response to 5.2:

Comment on Section 5.2 - re: Cleaning of old wells: "This is an entirely appropriate procedure which is essentially the same as that of developing a freshly drilled well and results in wells yielding samples of equivalent quality. Kennecott has already made note of those wells which cannot be cleaned to an acceptable standard and has or will plug them."

Response to 5.2:

- re: Filtering: "Kennecott's proposal to run both filtered and unfiltered analyses for metals is well taken. Only the results of filtered samples have sufficient consistency to be useful in developing a regional geochemical picture of the aquifer system. Unfiltered samples, no matter how carefully a borehole is constructed, will show wide variation from time to time and place to place due to the inclusion of varying amounts of solid material in them. The availability of both filtered and unfiltered samples will permit a careful evaluation of the extent to which sedimentary material influences the apparent total concentrations of dissolved constituents."

6.0 Sample Custody

6.1 Field Operations

2. Documentation of field sampling and observations should be recorded in a permanent record, i.e. field log book, to be signed by the responsible technician. All deviations from approved QA/QC must be noted.

(They are.)

(They will be.)

Table 6-1. Labels should be modified to include the time sample was taken and the number of well volumes evacuated prior to sample collection. The "Filtered" blank should be omitted to avoid possible confusion and errors, see reference 10.

(This is included on the field sheet for reference in the report.)

(Kennecott will continue to run filtered and unfiltered analyses.)

6.2 Laboratory Operations

KCC's laboratory and the Santa Fe laboratory should have their quality assurance program plan attached to this document.

(O.K., CEP's laboratory certification is included as Attachment 1.)

7.0 Calibration Procedures and Frequency.

7.1 General

Specification of standards, duplicates, spikes, etc., should be included for review and should be entered in the record.

(Kennecott's laboratory will complete the standards and spikes. Documentation of all of these will be conducted.)

7.2 Field Ph

Temperature compensation for extremes must be taken into account.

(Temperature and pH are recorded at the same time, and can therefore both be considered. Our pH meters are temperature compensating. What is meant by "temperature compensation fo extremes"?)

7.3 Field S.C.

(Yes.)

Temperature compensation for extremes must be taken into account. Notes on calibration should be included in permanent field log book. Effort must be made to watch the correction for temperature as samples and corrected to 25°C. This may be a problem due to the wide range needed to correct in the field.

7.4 No Chain of Custody Recorrd of Evidence of Sample Seals.-

(Filled out by the same field sampler(s) as indicated on the field sheets.)

7.5 Water level meters

Water level meters should be calibrated prior to each sampling episode, or more often if necessary and recorded. Annual calibration is inadequate.

(Meters do not need to be calibrated prior to each sampling round.)

7.6 Water Level Measurements

This section seems to indicate that monitoring wells have not been located by surveying. Permanent markings, located by a licensed surveyor at the same time finished well elevations are surveyed, must appear on each casing for water level measurements to be valid. These markings must identify the well and the elevation of the measured mark. Depth to bottom must also be determined at this time.

(Wells have been surveyed. Permanent markings will be completed.)

9.0 Data Reduction, Validation, and Reporting

Person responsible for reviewing analytical results should be specified. Methodology and person responsible for determination of unusually large or small concentrations and ordering reanalysis should be specified. (O.K.)

Individuals and responsibilities as given in sec. 3.0 should be identified. (O.K.)

10.0 Internal Quality Control Checks

10.1 Field Operations

The State recommends that 1 out of every 10 samples be a blind field duplicate. Specified splitting methodology does not follow Reference 10 guidance. All sampling plans by KCC must be referenced to this document. (O.K.)

Parameters that the SLC Health Department is certified to analyze should be specified. They should also have a written QA/QC plan attached to this document and they should specify submittal dates.

(No. The SLC Health Department should submit their own QA/QC plan so as not to hold this document up any longer.)

10.2 Laboratory Operations

Laboratory spikes and Blind audits should be addressed in this section, and will be submitted by the content laboratory before approval can be granted.

11.0 Performance and System Audits
To whom will the report be submitted, who will review the data and under what criteria before placing it on the computer? (Lynn Hutchinson)

13.0 Procedures used to Assess Data Precision, Accuracy and Completeness.

The laboratory will stay within their limits of detection and provide this information to the technical manager.

Lab spikes should be included as a means of verifying precision and the recovery of contamination.

Degree of completeness should be determined by this document and is locking.

(Data will be plotted using a statistical package that plots the data points and deviations for ease of pin-pointing outliers, prior to input into the computer.)

(See Intera's response attached.)

14.0 Analytical results supplied by the laboratory will be considered to be acceptable to Kennecott. The Technical Group may elect to reject data or request verification at any time. "Prior knowledge of site conditions" does not exist in sufficient detail to place any confidence in this statement. Field books must be available to the Technical Group for evaluation in the event of unexplained deviation or contradiction of the reasonably expected.

A second corrective action that may be required is the replacement of an inadequately constructed well. Criteria for this determination must be included in the QA/QC document as it is essential.

1. Verification of "gross contamination due to sample collection errors" will be accomplished by what means? How will these be reported?

2. -
3. -
4. As analysis related corrective action will be initiated only if a sample is contaminated or shows wide variation between duplicate analyses, reanalysis of existing samples appears redundant. There should be provision for re-sampling covering a wider range of potential problems.

(Resampling has been and will continue to be done, when questions still remain after reanalysis.)

15.0 QA Reports
Listing and basis for declaring data unacceptable must be accompanied by supporting rationale. (Good.)

QA Reports should include:

1. Listing of each well containing all pertinent information, i.e. condition, scaling, evacuation, etc. (On the field sheets.)
2. Initial report should include a determination of acceptability of construction of each well, with supporting rationale. (Completed in 1984; see Reports 1 & 2.)

Response to Section 13:

Comment on Section 13.0 - re: Procedures to assess data: "In addition to the laboratory procedures described by Kennecott, many of the samples will be examined for their consistency with the geochemical principles governing rock-water chemical interactions. Tests for mineral solubilities, for example, are useful in assessing the precision of pH measurements and some metals contents."

3. Depth to water table, depth to well bottom. (Completed. Reports 1 & 2.)
4. Silting
5. Identification of aquifer or aquifer flow zone being monitored.
6. Screened interval
7. Time well evacuated, time sample drawn.

16.0 References (Not valid. The reports were released following agreement.)
1. Technical group "approval" should not be construed to imply agreement. The report was approved for release.
2. As item #1

Section 40
Technical Specifications for Construction of Monitoring Wells

4.1.4 Depths (Will be done in the field via cuttings, geophysical logging.)
Depths cannot be determined for individual wells until hydrogeological data is gathered. This data must include but not be limited to an identification of the appropriate aquifers, hydrogeologic characteristics, and local hydraulic gradients.

4.1.5 Locations - (Not valid.)
Specific well locations are not approvable until requisite hydrogeological data has been gathered.

4.1.6 Plans and working drawings (To be done.)
As constructed plans of each well must be prepared and presented to the project enginner with finished geologists logs at the completion of the contract. This is essential to the evaluation of wells for compliance.

4.1.9 Request for Variance (Ric Jones. Dames & Moore.)
Identify Engineer. Must be familiar with QA/QC and insure compliance with plan.

4.2 Technical Specifications

4.2.1.1.1 Casing (Not valid.)
Use of PVC as well casing is unacceptable until non-reactivity with aquifer and potential contaminant fluids has been demonstrated. Teflon shall be used unless such demonstration is made.

4.2.1.1.2.
As above
Gaskets must also be demonstrated to be non-reactive and non-contaminating.

4.2.1.2 Screen
Centralizers shall be demonstrated to be non-reactive and non-contaminating. All screens shall be commercially slotted and shall be selected to be compatible with aquifer materials in the zone being monitored. Silting due to improper choice of screen size will be adequate basis to destroy and replace the well. (O.K.)

4.2.1.2.2

As Above

4.2.1.3. Sand Pack

Sand Pack should be chosen too prevent both filter-caking and silting. Comparison of geologist's notes with as-constructed plans and logs should be made to confirm appropriate selection. Silting of wells or improper gravel selection will be adequate basis to destroy and replace the well. (O.K.)

4.2.1.4

Not more than 6.5 gallons of water should be used in a slurry mixed in these proportions. Water must not contain contaminants, especially sulphates. Source must be identified. Use of an accelerator is not an approved practice as it may adversely impact the grout by inducing shrinkage. (O.K.)

4.2.1.5 Protective Well Covers

Well Cover material should be either a black or galvanized steel. (O.K.)

4.2.1.7

Teflon pipe is the only approvable casing material until non-reactivity and non-contamination are demonstrated for other materials. (Not valid.)

4.2.2. Construction of Monitoring Wells
The Engineer's report will be reported to whom? In what document? (To Kennecott. In Annual Progress Report

4.2.2.2.1 Drilling Methods
Fluid rotary and "any other drilling method" are unacceptable drilling methods. Other drilling methods must be identified and shown to not contaminate the boring with muds or introduced fluids. (Not valid.)

4.2.2.2.2 Drilling Fluids

Use of drilling fluids is prohibited. Industry standards do not exist for the use of drilling fluids in the drilling of RCP wells. Air rotary or cable tool should be adequate methods unless demonstration can be made to show otherwise.

(Not valid.)

4.2.2.3 Sampling

Sample collection method should be specified. If samples are to be used in the determination of hydraulic parameters, minimum criteria for determination of acceptability must be specified.

(Cutting samples and borehole geophysical logging will be used to define the subsurface geology.)

4.2.2.4 Driller's Logs

All boring logs should be prepared and dept by a geologist or geotechnical engineer present at all times during drilling and well installation. Logs should include the following items in addition to those noted in the plan:

(O.K.)

5. the depth and thickness of each saturated zone encountered.
6. Mineralogy
7. Structure
8. Lithology
9. Fining sequences
10. Rock types
11. Particle size and angularity
12. Rationale for selection of aquifer zone to be monitored.
13. Sieve analysis data, when applicable

4.2.7 Well Development

Well development fluids shall not be other than formation waters. Wells which do not develop to the point of being silt-free shall be reported to the Engineer and well construction shall be evaluated. If construction does not meet QA/QC specifications, the well shall be destroyed by grouting, and replaced.

(Well development fluids will be of drinking water quality and will be pumped out prior to sampling.)

Decontamination of tremie pipes, casing, drill rigs and auger flights should be addressed. Additionally, sample collection methods should be specified for both solid and liquid samples.

(Decontaminatio at this site where there are no organics is not applicable.

JH:dt
6408

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

Attachment 1

REF: 8ES-AS

Mr. James J. Mueller
Controls for Environmental Pollution, Inc.
1925 Rosina Street
Santa Fe, New Mexico 87502

Dear Mr. Mueller:

Based on the recommendations in the attached report, I am able to grant reciprocal certification to Controls for Environmental Pollution, Inc., for the radiochemical analysis of drinking water from Region VIII. The certification covers the following parameters:

gross alpha,
gross beta,
Radium 226,
Radium 228,
Tritium, and gamma photon emitters.

This reciprocal certification is subject to the regulations established by the State of New Mexico certification program. The laboratory must continue to participate in the EPA cross check and performance sample programs. The data must be within the acceptable limits defined by EPA/Las Vegas.

If you have any questions concerning this certification or the report, please contact Mr. Robert Tauer at (303) 234-3263.

Sincerely yours,

Woodall L. Payne
for Irwin L. Dickstein, Director
Environmental Services Division

TONEY ANAYA
GOVERNOR

STATE OF NEW MEXICO
ENVIRONMENTAL IMPROVEMENT DIVISION
P.O. Box 968, Santa Fe, New Mexico 87504-0968
(505) 827-9811
DENISE FORT, DIRECTOR

September 7, 1984

Certified Mail No. 264860
Return Receipt Requested

Mr. James Mueller
Controls for Environmental Pollution (CEP)
P. O. Box 5351 (1925 Rosina)
Santa Fe, New Mexico 87501

Subject: LABORATORY CERTIFICATION

Dear Mr. Mueller:

This is to advise you that pursuant to Section 309 of the Regulations Governing Water Supplies, your laboratory's certification is renewed for the September 7, 1984 thru April 30, 1985 certification period for the following parameters:

Gross alpha	Barium	Total coliform	Lindane
Radium-226	Chronium	Nitrate	Toxaphine
Radium-228	Mercury	Fluoride	2, 4, 5-TP
Uranium	Silver		Endrin
Cesium-137	Arsenic		Methoxychlor
Cesium-134	Cadmium		
Cobalt-60	Lead		
Tritium	Selenium		

This certification is based on the condition that your laboratory continues to meet the criteria set out in the "Water Supply Certification Manual" and demonstrates its ability to analyze for the presence of contaminants in drinking water within acceptable limits on Environmental Protection Agency (EPA) performance evaluation studies for certification of water supply laboratories.

Be advised that this certification is only for analytical measurements pursuant to the New Mexico Regulations Governing Water Supplies. This letter serves as your certification, and if this letter is to be used in any way, we require that it be quoted in its entirety.

Please contact Mr. Gustavo (Gus) Cordova, Program Manager with the Water Supply

Program at (505) 827-9805, in Santa Fe, if you have any questions concerning laboratory certification.

Sincerely,

Jon F. Thompson
Bureau Chief
Community Support Services Bureau
Certification Officer

JFT:eem

cc: EID District Managers
Gustavo Cordova, Prog. Mgr., WSS
Redolfo Romero, Dr., Chief/SLD Quality Assurance Bureau

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

THROUGH ITS ACCREDITATION COUNCIL HAS CONFERRED UPON

CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

ACCREDITATION FOR TECHNICAL COMPETENCE IN THE

CHEMICAL FIELD OF TESTING

AS LISTED IN THE CURRENT AALA DIRECTORY OF ACCREDITED LABORATORIES

PRESENTED THIS FIRST DAY

OF FEBRUARY, 1983

SEAL

EXECUTIVE DIRECTOR
FOR THE
BOARD OF DIRECTORS

CERTIFICATE NUMBER 215-01

OKLAHOMA WATER RESOURCES BOARD

Hereby Recognizes That

Centers for Environmental Pollution, Inc.

Laboratory No. 8208

is a participant in the Oklahoma Water Resources Board's LABORATORY CERTIFICATION PROGRAM and maintains on file a List of Parameters for which it is certified to perform analyses.

Done this 8th day of June, 1982

James R. Barnett Executive Director

This certificate is valid only for 1985

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Dianne R. Nielson, Ph.D., Division Director

355 West North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

March 18, 1985

Mr. Kenneth L. Alkema, Director
Division of Environmental Health
3266 State Office Building
Salt Lake City, Utah 84114

*(Kennecott's responses in parentheses.)

Dear Mr. Alkema:

Re: Kennecott Hydrogeologic Study Comments

The Division staff has reviewed the two reports prepared by Kennecott describing the five year study of the impacts on ground water resulting from mining activies in the Bingham Canyon area, Salt Lake County. Several major comments on these reports are presented in summary form in the body of this letter, while a detailed presentation of comments, with references to the individual reports, is presented in the attachment.

First, let me say tnat the intentions of Kennecott in attempting this study in an open manner are greatly appreciated. Many problems and miscommunications can occur when potential problems are kept in the dark. (Good.)

The first major concern raised by the Division's hydrology and geology staff was the limited understanding of the local subsurface geologic and hydrologic conditions. The works, which are referenced in ooth reports, are, at best, regional studies and are not suited to evaluating the site-specific ground water flow patterns and conditions. The Division strongly encourages that Kennecott further evaluate the local geology to provide a good physical model of subsurface conditions from which to develop a consistant model of the ground water regime. (Agreed. Phase I and II drilling programs will enable this.)

The differences raised, in the reports and in the February Technical Committee meeting, regarding the location at which separation of the shallow, unconfined and the deep, confined aquifers occurs, is also a concern. Unless this can be identified, questions will continue to be raised regarding the type of system that exists in the study area and the zones which must be monitored to evaluate ground water contamination.

(True. Please keep in mind that the Phase I drilling program is geared strongly to evaluating the hydrogeology in known and potential problem areas on and off site. This data will be used to define the Phase II detailed on-site drilling program required to define specific contaminant source migration rates and individual lateral and/or vertical plumes.)

Kennecott has indicated that some of this information will be collected from the 1985 drilling program. However, when the locations of the proposed wells are considered, they encircle the main area of concern (the area from the foothills of the Oquirrh Mountains eastward to the location of well W-108). The 1985 drilling program must include sufficient boreholes to allow identification of the subsurface bed lithology and extent and evaluation of the extent of the aquifer separation. (Phase I and II drilling will achieve this.)

A second major concern raised by the Division's staff was the apparent lack of background or baseline evaluation. A portion of the study is or should be to identify the contamination that occurs as a result of natural leaching versus that which occurs as a result of Kennecott's operation plus natural leaching. From our review, it did not appear that sufficient information was being or was to be collected to evaluate this question. (Intera Technologies is working on establishing background water quality, based on historic 1975-1985 data.)

Kennecott should expand sampling areas to identify natural background from adjacent drainages associated with the Bingham Canyon Mining District. The study should monitor for metals and contaminants which may have naturally leached from the mineralized ore body as described in Report #1. These concentrations should be compared to the concentrations found in the Kennecott mine area and the down gradient drainages. (The study covers a 200-square-mile area and includes springs and wells upgradient.)

I greatly appreciate your providing us an opportunity to comment on these reports. If you have any questions regarding the comments provided, please call Thomas Suchoski of my staff. He will be coordinating the review efforts of our agency.

Best regards,

Dianne R. Nielson
Director

TJS:tjs
0031R-19

March 18, 1985

Comments on Kennecott's
Ground Water Study

Report 1

Page 2 - Indicates that "Groundwater is used principally for industrial and irrigation purposes". What about private and city wells in the West Slopes District? (These use groundwater too, certainly.)

Page 7 - Natural leaching of metals may result from surface waters percolating through the mineralized rock units. When these waters enter the valley fill the metals are transported in solution.

- If this is the case, identify background water quality from all drainages which drain the Bingham Canyon Mining District. (Where possible, this work is ongoing by Intera Technologies, Inc.)
- Also, such natural leaching would be on-going and would not be expected to change with the development of the Bingham Canyon Mining District. (This is true for subareas within the district where active mining has not occurred. However, where mining has increased the exposure of the ore to air, oxidation and leaching would be increased.)

Page 8 - A 5.25 year study appears to be a bit long just to provide a final environmental impact evaluation. A more appropriate time frame would be 2.5 to 3 years. A five year time frame would be acceptible if it included a mitigation plan. (The final Environmental Impact Report will include an evaluation of potential remedial measures.)

Page 12 - Bingham Creek was and is used to convey mine drainage and leach fluid. No evaluation is presented as to whether Bingham Creek is a losing or gaining stream. This must be done.
(Bingham Creek is no longer a creek but has been rerouted and is a conveyance for treated mine waters to the evaporation ponds.)

- The leach collection system is stated to "prevent" loss of leach fluid. Perhaps a better word would be reduce or minimize. No evaluation is presented to demonstrate this. An evaluation of the losses from the leach fluid collection system should be considered.
(This has been considered, but it is an extremely difficult task. It is being considered as part of the ongoing surface water study.)

Page 14 - Regional Geology is addressed adequately, but the Report does not provide a detailed description of the local geology. For a study which is attempting to determine the movement and extent of contaminants in the ground waters of the valley fill materials, very little has been presented or is proposed to be undertaken to identify the geologic controls of the ground water regime. This is a significant knowledge gap which must be addressed to be able to more fully understand the ground water system. Kennecott should delineate the subsurface structure of the valley fill deposits. Such a delineation should include:

1. Cross-sections showing the unconsolidated material beds: clays, sands and gravels. (Yes.)

2. Evaluation and identification, on the cross-sections of water-bearing, unsaturated, and impermeable beds within the fill materials. (Yes.)

Without such a process, a good representation of the physical control in the subsurface cannot be applied to the study. (The data collected from Phase I and Phase II drilling and sampling will achieve these objectives.)

Page 21 - Discussion of the natural leaching process and the Kennecot Leaching operation indicate that elevated concentrations occur around Bingham Creek. What is the difference in concentrations caused by Kennecott plus natural leaching versus the elevated concentration caused by natural leaching? This needs to be identified to determine, if any, the problem Kennecott has caused. (At present, it is not certain if this can even be determined. This can be better assessed when Intera's background study is farther along.)

Page 23 - The report indicates the "Difficulty to correlate individual water-bearing zones throughout the valley fill." This may be true for the entire valley, but for the Kennecott study area this must be done to identify the potential impact on the ground water system. (Contaminant source area drilling will be conducted to define migration pathways and plume movement rates.)

Page 29 - The report indicates that the USGS has delineated the confined and shallow, unconfined aquifers beginning approximately 5 miles from the foothills of the Oquirrh Mountains. This is followed by a statement indicating Kennecott has identified a differentiation of the aquifer at a considerably lesser distance. Figures 19, 20 & 21 are presented as well-log cross-sections of the fill. A review of these cross-sections does not immediately show any real separation of aquifers any closer than five miles. Kennecott should incorporate boreholes to identify subsurface geologic conditions in the five (5) mile area eastward from the foothills of the Oquirrh Mountains. (Agreed. Phase I drilling, sites 1-5, are located to aid in such delineation.)

Page 30 - The shallow, unconfined aquifer is principally composed of clay, silt, and fine sand. This is different from the texture of the upper section of the valley fill depicted in Figure 19. (True. The subsurface geology varies throughout this area.)

- Kennecott must identify the subsurface conditions in the five (5) mile zone eastward from the Oquirrh Mountains. (Yes. We will, with Phase I & II drilling.)

Page 31 - What is the explanation for the pressure head of the deep, confined aquifer being equal to or greater than the overlying shallow aquifer in the area of evaporation ponds? (As stated in Hely's report (1971), this is not uncommon throughout the west valley area.)

Page 42 - Few of the proposed wells will add the knowledge and information needed to answer the question of aquifer separation. Kennecott should include a number of boreholes to identify subsurface geologic controls. (Not true.)

(Kennecott is drilling Phase I and II wells to define lateral and vertical hydrogeologic conditions.)

Report 2

Page 3 - Point 4 under the purpose now includes numerical simulation to be used in conjunction with analytical review. This is different from Report 1; why?

(The technical group agreed that this would be a valuable tool in defining rate and extent of plume movement as well as defining data gaps.)

Geology & Hydrology

Most all concerns raised under Report 2 were previously discussed under Report 1.

jvb
0184R

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322
UTAH WATER RESEARCH LABORATORY
UMC 82

COLLEGE OF ENGINEERING

March 18, 1985

Kenneth L. Alkema, Director
Division of Environmental Health
Department of Health
P.O. Box 2500
Salt Lake City, Utah 84110-2500

*(Kennecott's responses in parentheses.)

Dear Mr. Alkema:

The two reports released by Kennecott have been extremely valuable in our efforts to model ground water flow and solute transport along Bingham Creek. We were especially pleased with the amount of historical data released in the second report.

Determining the rate and direction of movement of the contaminant plume from the 500 million gallon reservoir is of primary importance. Data taken previous to 1975 would be helpful in estimating transport rates. Pre-1975 data should be released even if EPA sampling procedures and preservation techniques were not used. Early data for K84, K85, K120, K88, K26, and K86 are of particular interest. To state that "the data in section 8.3.2 seem to indicate that no rapid water quality changes appear to have occurred over the past 20-30 years" (Environmental Assessment Status Report, Oct. 1984, p. 87) is questionable when only 10 years of data are presented. Also, no data are given for P215 even though both reports indicate that this piezometer was included in the 1983-1984 round 1 sampling.

(No. It is on file at Kennecott, not to be published.)

(Please see the field sheet on P215, Report 1. Not enough water. The well has evidently collapsed at 40'.)

The proposed new monitoring well locations are adequate, with the exception of two areas. The first area is located about 1.25 miles east of the 500 million gallon reservoir. Figure 1 (enclosed) shows that average TDS drops from about 40,000 mg/l to only 2,000 mg/l in a relatively short distance. The front of the plume is either in this area or, the plume is sinking below current monitor wells. We cannot agree with the statement that: "Plume movement along Bingham Creek appears to have stablized (i.e., reached steady-state conditions) or regressed slightly" (Kennecott's Environmental Assessment Status Report, Oct. 1984, p. 76). Since three of the wells in this area have been eliminated (K86, K87, P196b), a deep, multi-level monitoring well should be installed to make up for this data gap. A suitable location would be between the old K86 and K87 sites, in line with the new wells at (C-3-2) 22 and (C-2-2) 10 as shown in Figure 1.

(Phase II.

The second area in which more information would be useful is the discharge area near the Jordan River. Although there are a few wells in this area, they are relatively shallow. A deep, multi-level sampling well

should be installed to monitor deeper aquifer zones. A suggested location is shown in Figure 2 (enclosed). (Phase II.)

The spacing and location of these wells just east of the dump leach areas appear adequate. These wells should be drilled to bedrock and, if sufficient depth is available, samples should be taken at various levels, not integrated over the entire depth of the aquifer. This will help to better determine the extent and direction of contaminant movement. (Agreed. Screened intervals will be minimized, where possible.

We hope that the above suggestions and comments will be helpful in your evaluation of the Kennecott study. If you have any questions, please do not hesitate to call.

Sincerely,

Calvin G. Clyde

Calvin G. Clyde
Professor of Civil Engineering

CGC/rf

Enclosures
c.c. Karen Holdsworth
L. Douglas James

Figure 1. Average TDS from leach dumps to the evaporation ponds.
- Well number
- Average TDS for period of record.
- ■ - KCC new well site
- ■ - suggested well site
- well eliminated

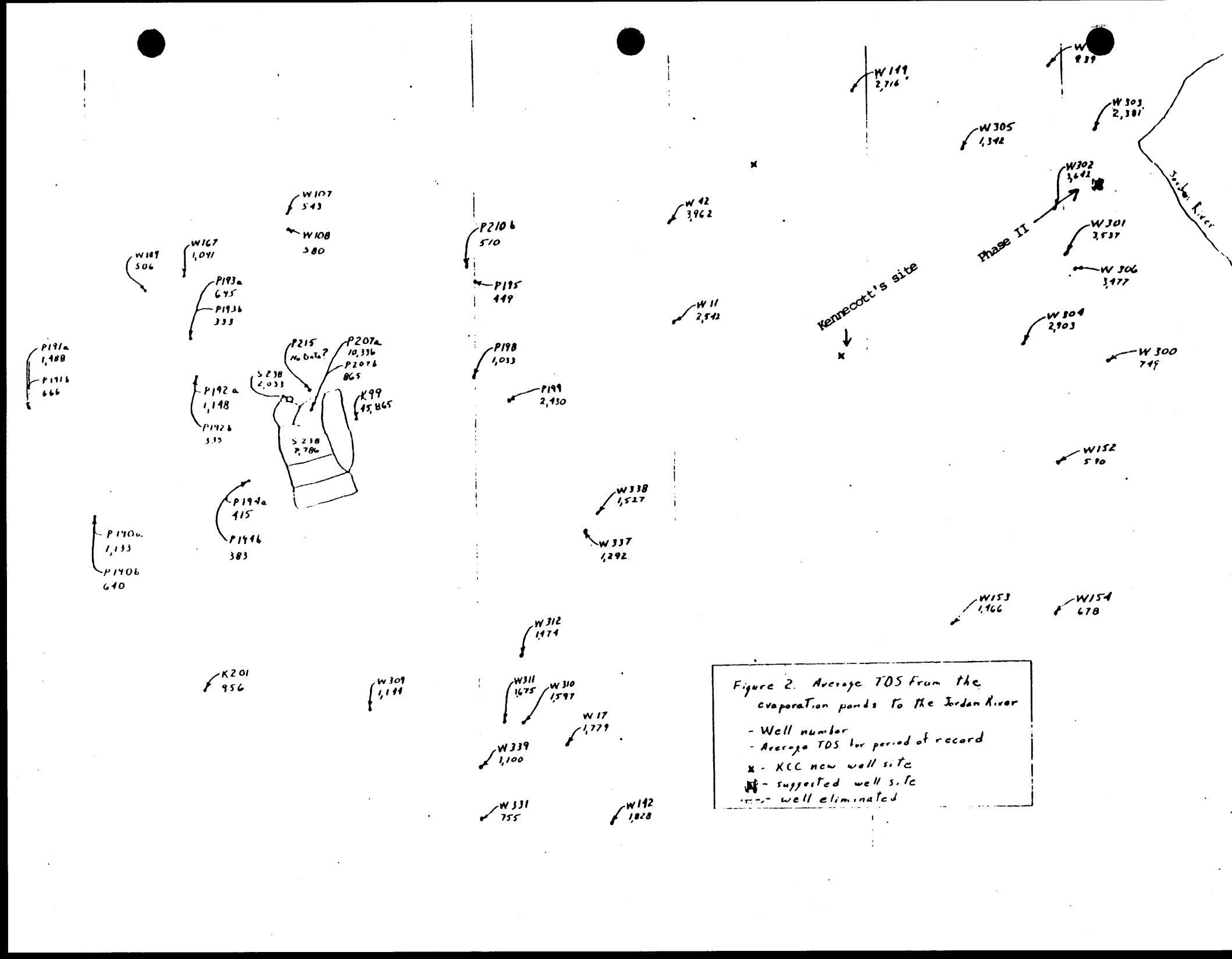

Figure 2. Average TDS from the evaporation ponds to the Jordan River

- Well number
- Average TDS for period of record
- x - KCC new well site
- ⊠ - suggested well site
- ~~-~~ - well eliminated

STATE OF UTAH
NATURAL RESOURCES
Utah Geological & Mineral Survey

606 Black Hawk Way · Salt Lake City, UT 84108-1280 · 801-581-6831

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Genevieve Atwood, State Geologist

March 15, 1985

Kenneth L. Alkema, Director
Division of Environmental Health
150 West North Temple
Salt Lake City, UT 84110-2500

Dear Ken:

*(Kennecott's responses in parentheses.)

This letter is in response to your request that we review Kennecott's "Environmental Assessment Status Report" (issued October, 1984) and "Geologic, Ground, and Surface Water Data Background and Progress Report" (issued June, 1984) and comment on their proposed locations for new monitoring wells. The reports have been reviewed with respect to our work on ground water in the Riverton and South Jordan area near Kennecott's evaporation ponds. This area includes Area 3 (figure 1, Environmental Assessment Status Report), in which Kennecott has documented changes in water quality downgradient from their old evaporation ponds. Degradation of water quality in two deep wells has occurred, but it is not known if the water in the deep aquifer is contaminated or if surface water or shallow ground water is leaking down the outside of the well casing and contaminating the water locally. The lack of contamination in other nearby deep wells indicates that the latter may be occurring. Kennecott plans two new well locations in Area 3 and a third to the south (NE1/4, sec. 19, T. 3 S., R. 1 W.). These locations are well-placed to help define conditions downgradient from the old evaporation ponds.

Water quality is presently monitored downgradient from the new evaporation ponds in private culinary wells. In the absence of confining beds beneath these ponds to protect the deep aquifer, and considering the large number of private and municipal culinary wells in the area, we suggest that monitoring of water quality continue and that water-level monitoring be implemented at selected wells. Monitoring of water levels (artesian pressures) in the deep aquifer before, during, and after filling of the evaporation ponds will help determine if leakage from the ponds is occurring. Evidence for recharge from the ponds will be detected more quickly from water-level monitoring than from water-quality monitoring. Water level records both up- and downgradient and in the pond area will be required to differentiate possible pond recharge from natural recharge. Existing wells at the ponds and downgradient to the east are adequate for this monitoring. However, wells upgradient appear to be either too far away to monitor water level changes due to natural recharge in the immediate pond vicinity or so close that they may be effected by mounding caused by possible pond leakage. A deep well in section 23, T. 3 S., R. 2 W. would provide less equivocal data for monitoring upgradient.

(Good point.

(Good!)

(Verbal communication with Gary on 3/25/85 resulted in (1.) The realization that Gary had not seen the latest revised proposed map for new monitor wells (attached), which I've since sent to him, (2.) He agreed that if we monitored water levels in the ponds, surrounding wells, Wells K201, P190A & B, and new Well 175 this spring, and did not see a correlation in water level fluctuations, there would be no need to put in a new well in S. 23, and (3.) He agreed with the concept of monitoring the fringe area first, and moving in to define details later on, i.e., Phase II.)

Wells between the new evaporation ponds and 4000 West Street (where basements were flooded in 1984) to determine water levels and quality in the shallow unconfined aquifer would also be valuable. These wells are of lower priority than the deep wells because it is believed that the shallow unconfined aquifer is absent beneath the ponds. However, shallow wells in the area would help define the extent of the shallow aquifer and any connection that may exist between it and the ponds.

(Kennecott has agreed to this with proposed Well 17S; see attached Figure 2.)

We will be happy to participate in any meetings in which our input may be useful. If you have any questions regarding our recommendations, please call.

Sincerely,

Gary E. Christenson

Gary E. Christenson
Geologist

GEC/bl

cc: Steve McNeal, Bureau of Water Pollution Control

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

MAR 28 1985

Ref: 8HWM-SR

Mr. Steve McNeal
Utah Department of Health
150 West North Temple Street
Salt Lake City, UT 84110

*(Kennecott's responses in parentheses.)

Dear Steve:

As requested by Ken Alkema, we have reviewed the reports on the Kennecott Study. We have the following comments relating to new monitoring during 1985.

1. In order to develop an adequate assessment of the potential for metals movement and of the waste rock piles, one to three monitoring wells should be drilled through the waste pile just south of the leach area. This will allow the quality of the water and the geochemical reaction to be directly monitored. The well may have to be drilled with a cable tool rig with driven casing. When water is encountered, the well should be completed to sample the top of the saturated zone. The well can be completed by inserting a PVC casing with 10' of screen into the steel casing. After adding a gravel pack, the casing can be jacked up ten feet to expose the screen and the well annulus sealed with bentonite. If the first well can be successfully completed, two more wells should be added. These should sample deeper zones. (Phase I monitor wells 1-5 are located east of the leach dumps to monitor ground-water impacts downgradient of the dumps. Phase II drilling will incorporate drilling within, upgradient and downgradient of the defined contaminant source areas, and can include 1 to 3 wells as outlined in 1 above.)

2. A serious effort, which utilizes metering of all segments of the leach process, should be undertaken to quantify the losses from the leach process. Infiltration and evaporation data will be needed to assess losses. (This is a very difficult task. However, Kennecott is pursuing this as part of the ongoing mine surface water study.)

3. Several additional wells are needed to assess changes in the ground water quality in area 1. Wells, p-234, p-228 and p-220 have a large sections of screened casing. This may mask large changes in metals from one zone to another. At least two additional depths should be sampled at each site. Well screens should not be more than 10-15 feet in length. The existing wells should be utilized for comparison. (Kennecott agrees with this comment, and has, as shown on Figure 2, proposed a total of 9 new wells to be completed in Phase I (sites 1-5), just east of the dumps.)

4. If the next sampling round verifies the data from p-202c, a new nested set of wells should be considered between K205-K07 and 15 S 1. This would be important for plume definition. (Kennecott agrees with this comment, but assumes that K07 is a typo and should read K70. These wells can be included in Phase II drilling, if the data indicate such a need, as you've indicated.)

5. At least one permanent monitoring well should be established in the bedrock near the Yosemite dump near Camp Williams.

(Kennecott is currently sampling 3 permanent wells in the Camp Williams area, Wells K-125, W-41 and W-126. The water quality in all 3 wells is good, and although Wells K-125 and W-41 are not deep, Well W-126 is 380' deep. In view of the fact that this area is not downgradient from an active leach dump and that the water quality from these wells is good, Kennecott believes that investing in a new monitor well to monitor contaminant sources, in Phase II, would be of much more value.)

7. A surface water sample should be collected up-stream from S-40. (Sample site S40 is located well above the disturbed mine areas, as seen in the water quality data, TDS = 341 ppm, SO4 = 36 in 1983. In view of the fact that Kennecott is sampling 7 other sites along Butterfield Creek downgradient, above and below disturbed mined areas, it is difficult to justify another site downgradient from the undisturbed site S40.) New wells immediately downgradient from the Lark tailings should be considered. That potential source needs to be characterized.

8. In general, consideration should be given to more nested sets of wells to better establish vertical quality gradients. This will be particularly important if reaction zones are identified. (Points 7 and 8 above are key considerations in Phase II on-site contaminant source migration definition.)

If you have any questions regarding these comments, please contact me at (303) 293-1596 or Paul Osborne at (303) 293-1418.

Sincerely,

Thomas F. Steible

for Rob Walline, Chairman
Mine Waste Task Force